

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
1 September 2005 (01.09.2005)

PCT

(10) International Publication Number
WO 2005/081067 A1

(51) International Patent Classification⁷: **G03F 7/20**

(21) International Application Number:
PCT/EP2004/014727

(22) International Filing Date:
27 December 2004 (27.12.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/544,967 13 February 2004 (13.02.2004) US
60/591,775 27 July 2004 (27.07.2004) US
60/592,208 29 July 2004 (29.07.2004) US

(71) Applicant (for all designated States except US): **CARL ZEISS SMT AG** [DE/DE]; Carl-Zeiss-Str. 22, 73447 Oberkochen (DE).

(72) Inventors; and

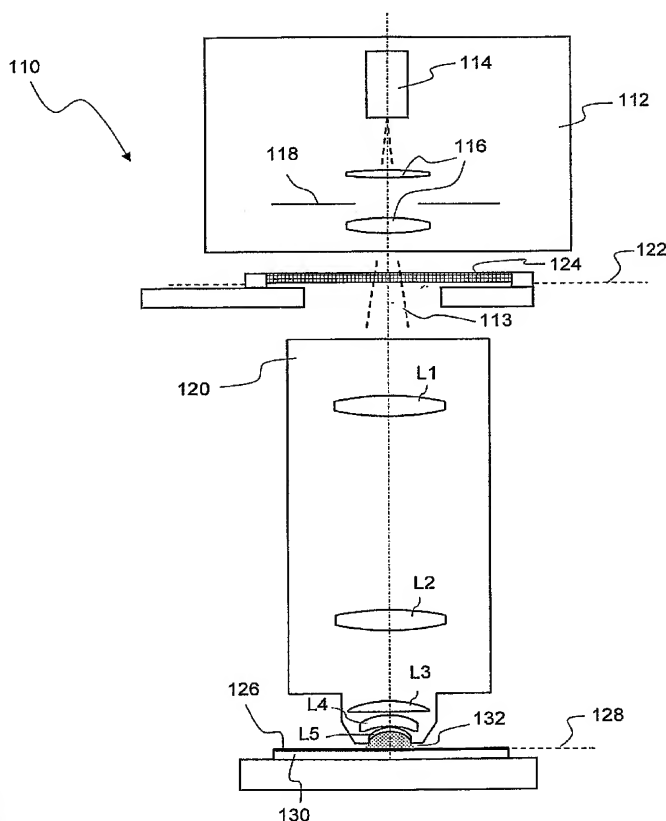
(75) Inventors/Applicants (for US only): **KNEER, Bernhard** [DE/DE]; Mühlenweg 9, 89605 Altheim (DE). **WABRA, Norbert** [DE/DE]; Am Ring 20, 97440 Werneck (DE). **GRUNER, Toralf** [DE/DE]; Opalstr. 22, 73433 Aalen-Hofen (DE). **EPPLE, Alexander** [DE/DE]; Langertstrasse 38, 73431 Aalen (DE). **BEDER, Susanne** [DE/DE]; Brandenburger Strasse 59, 73431 Aalen (DE). **SINGER, Wolfgang** [DE/DE]; Egerlandstrasse 45, 73431 Aalen (DE).

(74) Agents: **SCHWANHÄUSSER, Gernot** et al.; Ostertag & Partner, Eibenweg 10, 70597 Stuttgart (DE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,

[Continued on next page]

(54) Title: PROJECTION OBJECTIVE FOR A MICROLITHOGRAPHIC PROJECTION EXPOSURE APPARATUS



(57) Abstract: A projection objective of a microlithographic projection exposure apparatus (110) is designed for immersion operation in which an immersion liquid (134) adjoins a photosensitive layer (126). The refractive index of the immersion liquid is greater than the refractive index of a medium (L5; 142; L205; LL7; LL8; LL9). that adjoins the immersion liquid on the object side of the projection objective (120; 120'; 120''). The projection objective is designed such that the immersion liquid (134) is convexly curved towards the object plane (122) during immersion operation.



TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— *of inventorship (Rule 4.17(iv)) for US only*

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.